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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/941,142	08/28/2001	Jeffrey Meng Wah Chan	004-2628-1	7123

22120 7590 05/25/2005

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EXAMINER	
HUISMAN, DAVID J	
ART UNIT	**PAPER NUMBER**
2183	

DATE MAILED: 05/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/941,142	WAH CHAN ET AL.	
	Examiner	Art Unit	
	David J. Huisman	2183	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 April 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *21-55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *21-55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 August 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 21-55 have been examined.

Papers Submitted

2. It is hereby acknowledged that the following papers have been received and placed of record in the file: Extension of Time and Amendment as received on 4/19/2005.

Maintained Rejections

3. Applicant has failed to overcome the prior art rejections set forth in the previous Office Action. Consequently, these rejections are respectfully maintained by the examiner and are copied below for applicant's convenience.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 21-55 are rejected under 35 U.S.C. 102(b) as being anticipated by Barlow U.S. Patent Number 5,168,564 (herein referred to as Barlow).

6. Referring to claims 21, 32, and 45 Barlow has taught a method comprising; speculatively locking a resource to be accessed by execution of a first instruction, wherein the locking is performed prior to determining whether a hazard exists between the access and execution of a

second instruction (Barlow column 1 lines 50-61, column 2 lines 40-64; note that the locking is speculative because the system speculates that a hazard will exist among first and second RMW operations in the future, and therefore, it must lock the resource speculatively (ahead of time) in order to fix any hazard. It may turnout, however, that the locking has nothing to do with a hazard, but instead, with fixing a malfunctioning lock mechanism, which is done by locking a resource and then canceling read/write processing associated with that resource. See column 2, line 65, to column 3, line 5.)

7. Referring to claims 22, 34, and 46 Barlow has taught wherein the locking is performed prior to the first instruction entering a trap stage of an instruction pipeline (Barlow column 7 line 60-column 8 line 3, figure 4a, column 5 lines 9-18; the fault, which is the same thing as a trap, or exception, causes the cancel command, but this is after the lock has already occurred). It should be realized that a trap stage could be any point within the processing of the instruction in which a fault is fixed. Clearly, if a resource is already locked, and it needs to be unlocked (column 9, lines 35-36), then the locking is performed before the error is fixed in a "trap stage".

8. Referring to claims 23, 35 and 47 Barlow has taught wherein the first instruction is an atomic instruction including a portion to lock the resource and a portion to unlock the resource (Barlow column 1 lines 50-61, and column 8, lines 4-6; the resource is locked at the read portion and reset after the write portion of the operation).

9. Referring to claims 24, 36, and 48 Barlow has taught wherein the hazard includes a read-after-write hazard (Barlow column 1 lines 43-61; the resource is locked at the read portion and reset at the write portion of the operation). This prevents read-after-write hazards (RAW hazards) because a first operation will be able to write a result to a resource before a subsequent

operation reads from it (thereby preventing the subsequent instruction from reading incorrect data).

10. Referring to claims 25, 37, and 49 Barlow has taught wherein the locking includes: locking the resource during an effective address calculation stage of an instruction pipeline (Barlow column 4 lines 35-51, column 5 lines 9-19). Clearly, before a resource is locked, its location must be determined.

11. Referring to claims 26, 38, and 50 Barlow has taught wherein the locking includes locking at least a portion of a cache (Barlow column 5 lines 26-40, column 9 line 53-column 10 line 16).

12. Referring to claims 27, 39, and 51 Barlow has taught wherein the locking includes locking at least one memory address (Barlow column 5 lines 26-40, column 9 line 53-column 10 line 16; every entry in the cache is a memory address).

13. Referring to claims 28, 40, and 52 Barlow has taught further comprising unlocking the resource no later than a time at which the first instruction exits an instruction pipeline, regardless of whether the first instruction is cancelled (Barlow column 1 lines 50-61; the resource is locked at the read portion and reset after the write portion of the operation – after the write portion of the operation, the process is complete and therefore leave the pipeline). Clearly, when an instruction leaves the pipeline, all processing corresponding to that instruction will have been finished. Therefore, if an instruction specifies unlocking, then unlocking will have to occur before the instruction leaves the pipeline (completes).

14. Referring to claims 29 and 53 Barlow has taught wherein unlocking the resource includes:

unlocking the resource in the normal course of executing the computer instruction (Barlow column 1 lines 50-61; the resource is locked at the read portion and reset after the write portion of the operation – after the write portion of the operation, the process is complete and therefore leave the pipeline).

15. Referring to claims 30, 41, and 54 Barlow has taught wherein unlocking the resource includes preventing a write portion of the first instruction from altering information held in at least a portion of the resource (Barlow column 2 lines 40-64 – the other resources are not affected).

16. Referring to claims 31 and 55 Barlow has taught wherein preventing a write portion from altering information includes suppressing writing a value to an architectural storage location (Barlow column 2 lines 40-64; since the operation is being canceled, there will be no write-back to the registers).

17. Referring to claim 33 Barlow has taught further comprising a plurality of processing cores, wherein respective processing cores are adapted to lock the resource in response to respective accesses by respective first instructions prior to determining whether a hazard exists between the respective accesses and the second instruction (Barlow column 9 lines 3-26; multiple cores have access to the same resource).

18. Referring to claim 42 Barlow has taught a processor adapted to speculatively dispatch a load operation to a cache unit prior to determining whether read-after-write hazards associated with the load operation are present (Barlow column 1 lines 50-61, column 2 lines 40-64; the lock indicator, or mechanism can be canceled after it is set once it is determined that the command using the resource that is locked is invalid, therefore the resource is being locked before the

command has been determined to have hazards, and before the command is known to go until completion, which goes along with the definition of prior to a determination of a hazard in the instant application at page 2 line 23-page 3 line 4 – the first portion of a read modify write is a read from memory, which is the same as a load type instruction).

19. Referring to claim 43 Barlow has taught the processor of claim 42 wherein the processor is adapted to lock a resource associated with the load operation concurrently with dispatching the load operation (Barlow column 1 lines 50-61, column 2 lines 40-64; the lock indicator, or mechanism can be canceled after it is set once it is determined that the command using the resource that is locked is invalid, therefore the resource is being locked before the command has been determined to have hazards, and before the command is known to go until completion, which goes along with the definition of prior to a determination of a hazard in the instant application at page 2 line 23-page 3 line 4 – the first portion of a read modify write is a read from memory, which is the same as a load type instruction – the resource is locked during the read portion).

20. Referring to claim 44 Barlow has taught the processor of claim 43 wherein the processor is further adapted to unlock the resource associated with the load operation no later than a time at which an instruction implementing the load operation exits an instruction pipeline, regardless of whether the instruction is cancelled before exiting the instruction pipeline (Barlow column 1 lines 50-61; the resource is locked at the read portion and reset after the write portion of the operation – after the write portion of the operation, the process is complete and therefore leave the pipeline).

Response to Arguments

21. Applicant's arguments filed on April 19, 2005, have been fully considered but they are not persuasive.

22. Applicant argues the novelty/rejection of claims 21, 32, and 45 on pages 7-8 of the remarks, in substance that:

> "...the cancel command does not occur prior to determination of whether a hazard exists or determination of whether an operation is invalid. Indeed, the cancel command I issued with a read set lock command after "when it is discovered that it becomes desirable only to modify the state of the memory lock bit without disturbing the rest of the memory subsystem" (col. 8, lines 33 - 35). "When the CSS subsystem wants to reset the state of the memory lock bit, it generates a write lock reset command accompanied by a cancel command" (col. 9, lines 59 -62). It is clear that Barlow neither discloses nor suggests "speculatively locking a resource...prior to determining whether a hazard exists" as recited in claim 21"

23. These arguments are not found persuasive for the following reasons:

a) The examiner asserts that the locking is speculative because the system speculates that a hazard will exist (in the future) among first and second RMW operations, and therefore, it must lock the resource speculatively (ahead of time) in order to fix any hazard that may occur down the road. It may turnout, however, that the locking has nothing to do with a hazard, but instead, with fixing a malfunctioning lock mechanism, which is done by locking a resource and then canceling read/write processing associated with that resource. See column 2, line 65, to column 3, line 5.)

24. Applicant argues the novelty/rejection of claims 21, 32, and 45 on pages 7-8 of the remarks, in substance that:

> "Claim 42 recites "a processor to speculatively dispatch a load operation to a cache unit prior to determining whether read-after-write hazards associated with the load operation are present." Barlow does not disclose or suggest a processor to dispatch a load operation to a cache unit, and especially does not disclose such a processor to dispatch prior to determining whether a read-after-write hazard is present."

25. These arguments are not found persuasive for the following reasons:

a) It should be realized that load/read operations first try to load data from a cache. In this case, Fig.1 and Fig.2 of Barlow both show on-board CPU cache units from which data would be loaded. In addition, from column 1, lines 43-61, it should be realized that an RMW operation includes a load/read portion. The location from which data will be loaded will be locked and the load will be dispatched for execution. This would be done prior to determining whether any RAW hazards exist. Specifically, see column 1, lines 57-61, and note that "if a second processing unit should attempt to access the same [locked] memory location...the memory subsystem will send a busy signal indicating that the memory location is in use." That is, a second operation may not access the same location but if it does, a hazard exists (a second operation is trying to read a location before it is correctly modified by the first operation), and the hazard is fixed by the locking of the resource that occurred when the first operation was first encountered (speculative locking).

26. Applicant argues the novelty/rejection of claims 22, 34, and 46 on pages 8-9 of the remarks, in substance that:

> "Barlow...does not disclose or suggest "wherein the locking is performed prior to the first instruction entering a trap stage of an instruction pipeline" as recited in claim 22, and similarly in claims 34 and 46. The Office basis the rejection of these claims on the sole argument that a fault is a trap, disregarding the actual claims."

27. These arguments are not found persuasive for the following reasons:

a) A trap is merely a point that invokes some type of handling, whether it be for correction or some other purpose. Traps, faults, exceptions, interrupts, etc., are similar terms, as the previous examiner pointed out. Taking the broadest reasonable interpretation of the claims in question, a

trap stage could be any stage within the processing of the instruction in which a fault is fixed. Clearly, if a resource is already locked, and it needs to be unlocked (column 9, lines 35-36), then the locking is performed before the error is fixed in a "trap stage".

28. Applicant argues the novelty/rejection of claims 23, 35, and 47 on page 9 of the remarks, in substance that:

> "With regard to claims 23, 35, and 47, the Office asserts that Barlow teaches an atomic instruction as recited in the claims. The Office refers to the disclosure of a read-modify-write operation in the background section of Barlow. Nothing in this section discloses an atomic operation including a portion to lock a resource and a portion to unlock the resource. In fact, Barlow actually discloses 2 separate instructions to implement the RMW operation: the read set lock command and the write reset lock command."

29. These arguments are not found persuasive for the following reasons:

a) A read-modify-write operation is a common operation that is viewed as being an "instruction," as it the operation itself instructs the system to perform something. It is further viewed as an instruction because the read, modify, and write portions are performed atomically. i.e., they are not interrupted. So, there is in fact a read portion, which locks a resource, and a write portion, which unlocks a resource (column 1, lines 53-57), and these portions are atomically performed to ultimately instruct the system to perform a "read-modify-write" operation.

30. Applicant argues the novelty/rejection of claims 24, 36, and 48 on page 9 of the remarks, in substance that:

> "There is no disclosure of a read-after-write hazard in the section relied upon by the Office or in any other section of Barlow."

31. These arguments are not found persuasive for the following reasons:

a) Locking and unlocking of resources for RMW operations is specifically useful in preventing RAW hazards. A RAW hazard is when a subsequent operation reads a memory location that is to be modified by a previous instruction. This could be a problem in the case where the subsequent instruction reads the location before it is modified by the previous instruction, thereby resulting in the reading of incorrect (not up-to-date data). The locking prevents read-after-write hazards (RAW hazards) because a first operation will be able to write a result to a resource before a subsequent operation reads from it. By unlocking the resource only after it is written to by the previous instruction, proper reading by the subsequent instruction is ensured. Hence, RAW hazards are inherently a part of Barlow.

32. Applicant argues the novelty/rejection of claims 25, 37, and 49 on pages 9-10 of the remarks, in substance that:

> "Barlow fails to disclose or suggest "locking the resource during an effective address calculation stage of an instruction pipeline."

33. These arguments are not found persuasive for the following reasons:

a) Clearly, before a resource is locked, its location/address must be determined. The process of determining which resource to lock and then locking it is part of an "effective address calculation stage" of the pipeline.

34. Applicant argues the novelty/rejection of claims 28, 40, 43-44, and 52 on page 10 of the remarks, in substance that:

> "With regard to claims 28, 40, 43-44 and 52, the Office refers to Barlow's disclosure of a RMW operation. The Office states that "the resource is locked at the read portion and reset after the write portion of the operation - after the write portion of the operation, the process is complete and

> therefore leave the pipeline." However, there is not indication of any disclosure or suggestion in Barlow for the actual limitations of the rejected claims."

35. These arguments are not found persuasive for the following reasons:

a) This feature is also inherently present within Barlow. Clearly, when an instruction leaves the pipeline, all processing corresponding to that instruction will have been finished (as leaving the pipeline signifies completion). Therefore, if an instruction specifies unlocking, then unlocking is part of processing the instruction, and therefore, the unlocking will have to occur before the instruction leaves the pipeline (completes).

Conclusion

36. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David J. Huisman whose telephone number is (571) 272-4168. The examiner can normally be reached on Monday-Friday (8:00-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DJH
David J. Huisman
May 16, 2005

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